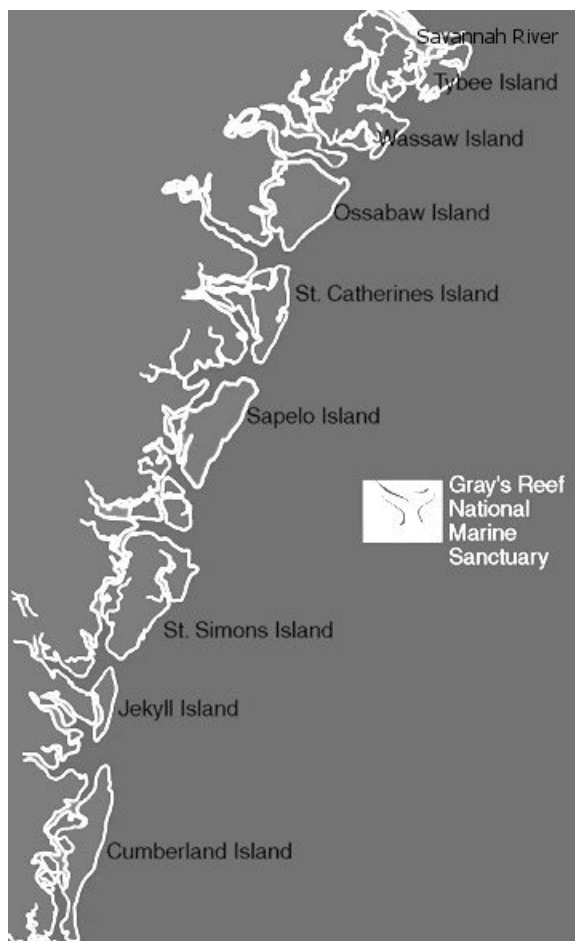


Cruise Report

Gray's Reef National Marine Sanctuary: A Survey of Soft-Bottom Macroinfaunal Assemblages and Levels of Chemical Contaminants in Sediments and Biota



NOAA

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



National Ocean Service

National Centers for Coastal Ocean Science

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Gray's Reef National Marine Sanctuary: A Survey of Soft-Bottom Macroinfaunal Assemblages and Levels of Chemical Contaminants in Sediments and Biota

April 2000

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Preface

This cruise report is a summary of field work conducted in the Gray's Reef National Marine Sanctuary (GRNMS), April 2000, as part of a two-year study to assess the condition of macroinfaunal assemblages, concentrations of chemical contaminants in sediments, and contaminant body-burdens in target benthic species of GRNMS soft-bottom habitats. A total of 20 stations were sampled April 3-7, 2000 from the NOAA ship FERREL (Cruise FE-00-06-GR). These stations were chosen using a random sampling design to support probability-based estimates of environmental condition with respect to the various measured indicators.

The field work described herein was conducted by scientists and staff from the following NOAA organizations:

- NOAA, National Ocean Service (NOS), National Centers for Coastal Ocean Science (NCCOS), Center for Coastal Monitoring and Assessment (CCMA) – Charleston, SC office.
- NOAA, NOS, Office of Ocean and Coastal Resource Management (OCRM), National Marine Sanctuary Program, Gray's Reef National Marine Sanctuary, Savannah, GA.
- NOAA, Office of Marine and Aviation Operations (OMAO), NOAA Ship FERREL.

The work, sponsored by the National Marine Sanctuary Program, is a component of a broader coordinated site characterization of the sanctuary by the GRNMS office, CCMA, and two other NCCOS centers: the Center for Coastal Fisheries Habitat Research (CCFHR) and the Center for Coastal Environmental Health and Biomolecular Research (CCEHBR).

Additional copies of this cruise report can be obtained by contacting:

1. NOAA, NOS, National Centers for Coastal Ocean Science, Center for Coastal Monitoring and Assessment, Regional Monitoring Team, 217 Fort Johnson Road (P.O. Box 12559), Charleston, South Carolina, 29422-2559, Telephone: 843/762-5415; or
2. NOAA, NOS, National Centers for Coastal Ocean Science, Center for Coastal Monitoring and Assessment, N/SCI1, SSMC-4, 1305 East-West Hwy, Silver Spring, MD 20910-3281, Telephone: 301/713-3028.

1.0 Introduction

This field work was conducted to assess the condition of macroinfaunal assemblages, concentrations of chemical contaminants in sediments, and contaminant body-burdens in target benthic species of the Gray's Reef National Marine Sanctuary (GRNMS) off the coast of Georgia. Prior research in the sanctuary has focused primarily on the impressive live-bottom assemblages of algae, invertebrates, fishes, and turtles associated with rock outcrops. In contrast, there has been limited work on the ecology of unconsolidated substrates surrounding the rocky-reef structures. The present study will provide a comprehensive baseline on condition of the soft-bottom benthos and background contaminant levels of this important natural underwater resource.

The purpose of Cruise FE-00-06-GR was to obtain samples for the Year-1 research effort. Samples were collected at 20 random stations during the week of April 3-7, 2000, using the NOAA Ship FERREL. At each station, samples and in-situ measurements were obtained for characterization of: (1) biodiversity and abundances of macroinfauna (> 0.5 mm); (2) concentration of sediment contaminants (metals, pesticides, PCBs, PAHs, porewater sulfide); and (3) general habitat conditions (water depth, dissolved oxygen, salinity, pH, temperature, water clarity, % silt-clay versus sand content of sediment, organic-carbon content of sediment). Biota of commercial or ecological importance were collected as well (by divers and fish traps) and will be analyzed for contaminant levels in tissues.

Follow-up sampling will be conducted during the second year (spring 2001) to: (1) test for inter-annual and spatial variability in macroinfaunal distributions and (2) provide a closer look at specific areas where there may have been evidence of contaminant and/or bioeffect signals. Tests of spatial variability in benthic fauna will include near-field and far-field comparisons to test for any differences that might be coupled to natural factors, such as foraging by reef species, or to potential anthropogenic influences associated with proximity to land. Follow-up work in any potentially degraded areas also would include toxicity testing in addition to the re-sampling of biological and chemical parameters. Preliminary results of the first year will be used to help select station locations and analyses for the second year.

2.0 Scientific Approach

A total of 20 stations (Table 1 and Figure 1) were sampled April 3-7, 2000 from the NOAA Ship FERREL. A random sampling design was applied to support probability-based estimates of environmental condition with respect to the various measured indicators. The resulting sampling framework was a 58-km² grid of 20 individual cells (2.9 km² each). An effort was made to establish stations in unconsolidated substrates away from confirmed locations of live bottom (e.g., see Figure 1). If the original target coordinates for any station ended up being in unsuitable substrate, a new set of random coordinates was selected from the list shown in Appendix A. Only two stations had to be moved from the original target location to one of their alternate locations (GR00012d and GR00018e).

At each station, samples and in-situ measurements were taken for characterization of: (1) general habitat conditions (depth; water temperature, salinity, pH, and dissolved-oxygen; total

organic carbon, silt-clay, and water content of sediment); (2) potential pollution exposure (sediment contaminant concentrations and sulfide in sediment porewater); (3) structure and composition of macroinfaunal assemblages; and (4) aesthetic quality (presence of anthropogenic debris, visible oil, noxious sediment odor, and water clarity based on secchi depths). Depth and water-quality parameters (dissolved oxygen, temperature, pH, and salinity) were measured in surface, mid and near-bottom waters instantaneously with a “Datasonde 3” multiprobe data logger. Benthic macroinfauna were sampled in triplicate with a 0.04-m² Young grab. The benthic samples were sieved onboard through a 0.5-mm screen and preserved in 10% buffered formalin (with Rose Bengal stain added to facilitate subsequent sorting in the laboratory). One meiofauna sample was collected at each station (approximately 0.02m² surface sediment; upper 2-3 cm) and preserved in 10% buffered formalin with Rose Bengal stain. Samples for the analysis of sediment contaminants, % silt-clay, % water, and % total organic carbon (TOC) were sub-sampled from composited surface sediment (upper 2-3 cm) collected from multiple grabs independent of the macroinfaunal grabs.

Summaries of these parameters and corresponding sampling protocols are given in Tables 2 and 3. Quality-control tolerance ranges for Datasonde instrument calibrations and field measurements are provided in Table 4.

In addition, samples of a target benthic species were collected from the sanctuary for the analysis of contaminants in tissues. Arc shells (*Arca Zebra*), commonly referred to as the “turkey wing,” were collected by scuba divers at station GR00007 and black sea bass (*Centropristitis striata*) were collected by fish trap from station GR00008. Samples were left whole, wrapped in pre-cleaned foil, placed in plastic bags, labeled and maintained frozen.

3.0 Sampling Logistics and Scientific Parties

The 20 randomly chosen stations were sampled on April 3-7, 2000 from the NOAA ship FERREL, cruise FE-00-06-GR. All samples were collected from the deck of the FERREL except for the scuba diving operation to collect *Arca zebra*, which used the FERREL launch FE-2. The scientific crew consisted of three staff from NOAA, NOS, NCCOS, Center for Coastal Monitoring and Assessment, Charleston Office and two staff from NOAA, NOS, National Marine Sanctuary Program, Gray’s Reef National Marine Sanctuary. During the cruise the scientific crew was joined by two pairs of students from the Savannah Student Ocean Council that were switched out part way through the week. Sampling time at each station ranged from 20 minutes to 65 minutes and averaged about 40 minutes. A summary of field logistics and scientific parties is given in Table 5.

4.0 Preliminary Results

All in-situ measurements and records of sampling were recorded on standard field sheets. A randomly selected station was sampled in each of the 20 individual cells, thus it will be possible to make probabilistic estimates of environmental condition. Copies of the field sheets with the recorded raw data are included in Appendix B. Quality Control calibration records for the Datasonde instruments are included in Appendix C.

Average depth at the 20 stations sampled within the boundaries of Gray's Reef National Marine Sanctuary was 18.26m and ranged from 14.5 to 21.1m. Water temperature ranged from 17.59°C to 18.83°C and averaged 18.06°C. The average salinity was 33.75 ‰ and ranged from 32.9 to 34.3 ‰. Dissolved oxygen (DO) within the sanctuary boundaries averaged 7.92 mg/L with a range of 7.47 – 8.41 mg/L. These DO levels are well above the general water quality standard of 5 mg/L used by many states to protect the more sensitive species and life stages.

The sediments of the soft-bottomed habitats of GRNMS consisted mostly of light-brown, coarse sand with shell hash, typical of offshore sediments in this area of the continental shelf. A wide variety of animals were visible to naked eye in the sediment samples collected to characterize the macroinfaunal assemblages. Animals that were commonly seen include molluscs, crustacea, polychaetes, sponges, and echinoderms. Members of the Cephalochordata (commonly called lancelets) were also encountered at numerous stations.

5.0 Ship Operations Evaluation Form

A copy of the Ship Operations Evaluation Form for NOAA ship FERREL cruise FE-00-06-GR is included in Appendix D.

6.0 Acknowledgements

Funding for this field work is provided by the NOAA National Marine Sanctuary Program.

All members of the field crew (see Table 5 for lists) are commended for their high level of technical expertise, teamwork and dedication to getting the required sampling completed. Special appreciation also is extended to the officers and crew of the NOAA ship FERREL for the superb job performed on FE-00-06-GR in the Gray's Reef National Marine Sanctuary.

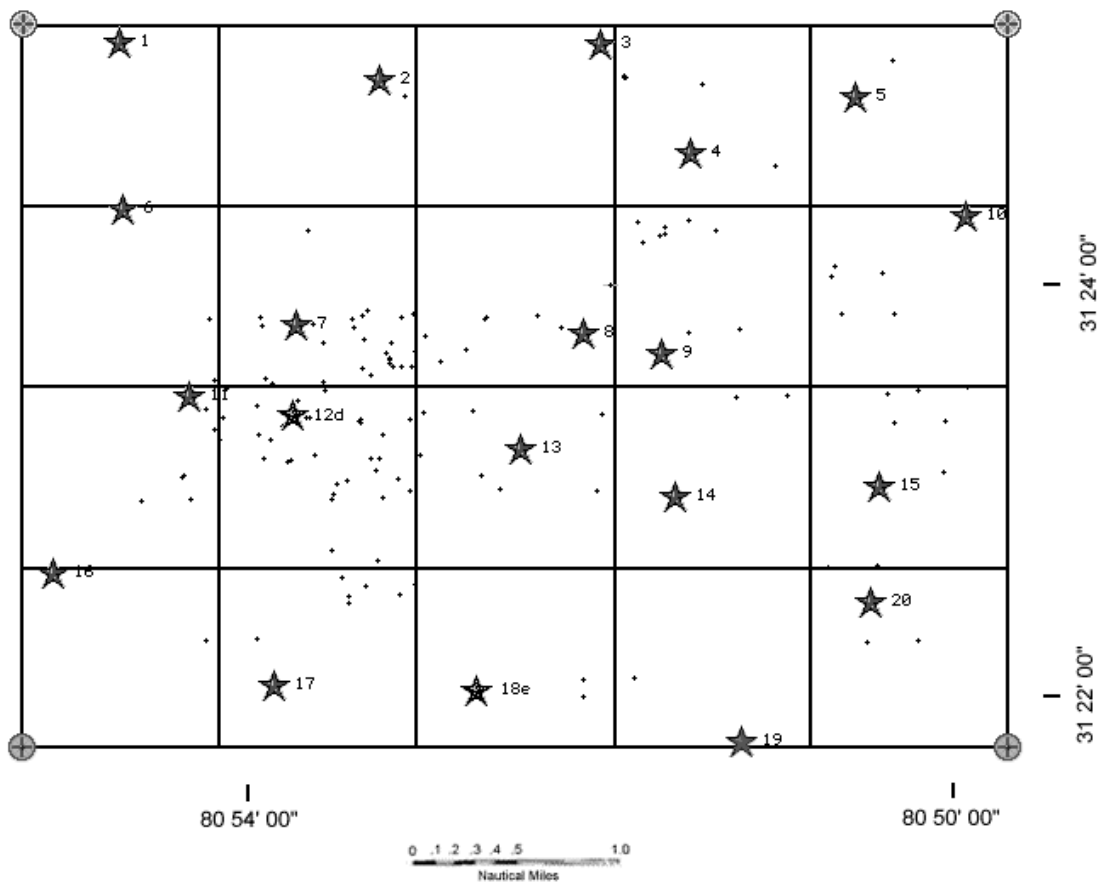


Figure 1. Locations of soft-bottom sampling sites (numbered stars) in relation to Gray's Reef National Marine Sanctuary boundaries (crosshairs). Each sampling cell measures 0.875 minutes of latitude by 1.117 minutes of longitude. Small cross marks indicate locations of confirmed live bottom, based on MARMAP data (McGovern, personal communication).

Table 1. Coordinates of soft-bottom sampling sites at Gray's Reef National Marine Sanctuary (FERREL Cruise FE-00-06-GR).

Station ID	Latitude		Longitude	
	(Deg)	(Min)	(Deg)	(Min)
1	31	25.16894	-80	54.73736
2	31	24.99087	-80	53.26813
3	31	25.16233	-80	52.00844
4	31	24.63501	-80	51.50174
5	31	24.91900	-80	50.28300
6	31	24.36797	-80	54.71978
7	31	23.80994	-80	53.73411
8	31	23.76791	-80	52.10619
9	31	23.66897	-80	51.66198
10	31	24.33443	-80	49.94133
11	31	23.46176	-80	54.34569
12d	31	23.37043	-80	53.75872
13	31	23.20901	-80	52.46420
14	31	22.98005	-80	51.58678
15	31	23.02333	-80	50.42997
16	31	22.61080	-80	55.11392
17	31	22.05454	-80	53.86067
18e	31	22.02829	-80	52.71509
19	31	21.78175	-80	51.21248
20	31	22.45563	-80	50.48279

Table 2. Summary of field samples collected at each station.

Parameters	# Replicates	Container Type	Sample Size	Preservation
Infauna	3 (0.04 m ² Young grab, 0.5 mm sieve)	500 ml Polypropylene jar	All material retained on 0.5 mm sieve	10% buffered formalin in field. Transferred to 70% ethanol within ~ 1 month.
Metal Contaminants	1 (Composited upper 2 cm of sediment from multiple grabs.)	250 ml HDPE jar	2/3 Full	Frozen (-20°C).
Organic Contaminants	1 (Composited upper 2 cm of sediment from multiple grabs.)	500 ml I-Chem glass jar	2/3 Full	Frozen (-20°C).
TOC	1 (Composited upper 2 cm of sediment from multiple grabs.)	125 ml Polypropylene jar	2/3 Full	Frozen (-20°C).
Silt-Clay & % Moisture	1 (Composited upper 2 cm of sediment from multiple grabs.)	500 ml HDPE jar	2/3 Full	Frozen (-20°C).
Meiofauna	1 (Upper 2-3 cm of sediment from half surface area of one grab, ~ 0.02m ²)	500 ml Polypropylene jar	2/3 Full	10% buffered fomalin in field. Transferred to 70% ethanol within ~ 1 month
AVS	1 (Removed upper 2 cm plug of sediment from one grab)	30 ml Polypropylene jar	Full	Frozen (-20°C).

Table 3. Summary of in-situ measurements collected at each of the 20 stations.

• Station depth (boat fathometer)
• Presence of surface debris
• Visible Oil (on sea surface, in bottom sediment grabs)
• Noxious odors in sediment grabs (H ₂ S, sewage, oil)
• Visible appearance of grabs (sediment color, sediment type, visible biota)
• Secchi depth
• DataSonde pre-deployment calibration checks (see QC tolerance ranges, Table 4)
• DataSonde instantaneous profiles (depth, temperature, salinity, pH, DO, conductivity)
- Surface
- Mid
- Near-bottom

Table 4. Quality control tolerance ranges for Datasonde instrument calibration and field measurements.

Frequency of Check	Parameter	Checked Against	Max. Acceptable Difference
Pre-survey Calibration	Temperature	Thermometer	± 1 °C
	Salinity	Standard seawater	± 0.2 ‰
	DO	Manufacturer's setting	± 0.3 mg/L
	% Sat. DO	Manufacturer's setting	± 2.5 ‰ (100 – 105% range)
	pH	pH buffer solution	± 0.1 pH units
Pre-Deployment Field Comparison	Temperature	Deployed vs. Back-up Datasondes	± 1 °C
	Salinity	Deployed vs. Back-up Datasondes	± 1 ‰
	DO	Deployed vs. Back-up Datasondes	± 0.3 mg/L
	pH	Deployed vs. Back-up Datasondes	± 0.3 pH units

Table 5. Field logistics summary.

Date	Vessel	Scientific Crew	Launch Site, Staging Area	Field Activities
04/02/00	NOAA Ship FERREL	J. Hyland*, L. Balthis*, C. Cooksey*	In port at Priest's Landing	Arrive Savannah, GA. Sampling preparation and orientation.
04/03/00	NOAA Ship FERREL	J. Hyland, C. Cooksey, L. Balthis, R. Rogers ^o , C. Sakas ^o , H. Ferguson ⁺ , D. Haus ⁺	Depart Priest's Landing for GRNMS	Sample Stations 001, 002, 003, 004, 005, 008 ^a , 009 and 010.
04/04/00	NOAA Ship FERREL	J. Hyland, C. Cooksey, L. Balthis, R. Rogers, C. Sakas, H. Ferguson, D. Haus	Return to Priest's Landing due to rough seas.	No Sampling. Use time to process samples and instruct students.
04/05/00	NOAA Ship FERREL	J. Hyland, C. Cooksey, L. Balthis, R. Rogers, C. Sakas, N. Fleming ⁺ , A. Dowling ⁺	Depart Priest's Landing for GRNMS	Sample Stations 008 ^a , 006, 007, 011, 012, and 013.
04/06/00	NOAA Ship FERREL	J. Hyland, C. Cooksey, L. Balthis, R. Rogers, C. Sakas, N. Fleming, A. Dowling	At sea, GRNMS	Sample Stations 014, 015, 016, 017, 018, 019 and 020.
04/07/00	NOAA Ship FERREL	J. Hyland, C. Cooksey, L. Balthis	Return to Priest's Landing	Demobilization. Depart for Charleston, SC.

^a Returned to station GR00008 on 04/05/00 to complete the macroinfaunal and chemistry sampling.

Affiliations:

*NOAA, National Ocean Service (NOS), National Centers for Coastal Ocean Science (NCCOS), Center for Coastal Monitoring and Assessment (CCMA) – Charleston, SC Office; ^oNOAA, NOS, Office of Ocean and Coastal Resource Management (OCRM), National Marine Sanctuary Program, Gray's Reef National Marine Sanctuary (GRNMS), Savannah, GA; ⁺Savannah Students Ocean Council, Savannah, GA.

APPENDIX A

Alternate Gray's Reef Sampling Locations: Cruise FE-00-06-GR

Appendix A. Alternate Gray's Reef sampling locations.

Station ID	Latitude (deg.) (min.)		Longitude (deg.) (min.)	
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Targeted stations:

1	31	25.16894	-80	54.73736
2	31	24.99087	-80	53.26813
3	31	25.16233	-80	52.00844
4	31	24.63501	-80	51.50174
5	31	24.90448	-80	50.56879
6	31	24.36797	-80	54.71978
7	31	23.80994	-80	53.73411
8	31	23.76791	-80	52.10619
9	31	23.66897	-80	51.66198
10	31	24.33443	-80	49.94133
11	31	23.46176	-80	54.34569
12	31	22.79507	-80	53.62935
13	31	23.20901	-80	52.46420
14	31	22.98005	-80	51.58678
15	31	23.02333	-80	50.42997
16	31	22.61080	-80	55.11392
17	31	22.05454	-80	53.86067
18	31	22.47458	-80	52.31522
19	31	21.78175	-80	51.21248
20	31	22.45563	-80	50.48279

Alternate station locations:

1a	31	25.02439	-80	54.50313
2a	31	24.57932	-80	53.25195
3a	31	24.99363	80	52.84243
4a	31	24.49147	-80	51.60384
5a	31	24.90956	-80	50.61805
6a	31	24.11827	-80	55.14342
7a	31	23.96436	80	53.16214
8a	31	23.72102	80	52.69979
9a	31	23.93464	-80	51.30378
10a	31	23.85945	-80	50.81287
11a	31	23.30304	-80	54.29256
12a	31	23.06906	-80	53.67837
13a	31	23.03712	-80	52.99927
14a	31	22.74514	-80	50.84307
15a	31	22.77856	-80	50.68549
16a	31	22.42377	-80	55.19349
17a	31	21.96101	-80	53.27500
18a	31	22.48131	-80	52.93399
19a	31	21.86364	-80	51.02665
20a	31	21.96000	-80	50.32838

Appendix A. Continued.

Station ID	Latitude		Longitude	
	(deg.)	(min.)	(deg.)	(min.)
1b	31	24.49817	-80	54.40547
2b	31	24.47093	-80	53.11353
3b	31	24.86845	80	52.58438
4b	31	25.19175	-80	51.42815
5b	31	25.00125	-80	50.53924
6b	31	23.78542	-80	54.39382
7b	31	23.73686	80	53.28456
8b	31	24.34356	80	52.07317
9b	31	24.10204	-80	51.75088
10b	31	23.52627	-80	50.46425
11b	31	23.48396	-80	54.29091
12b	31	22.87713	-80	53.11340
13b	31	23.41465	-80	52.68194
14b	31	23.04220	-80	51.07432
15b	31	23.40854	-80	50.45593
16b	31	21.98181	-80	54.25045
17b	31	22.40340	-80	53.30809
18b	31	22.22803	-80	52.42268
19b	31	22.46294	-80	51.09651
20b	31	22.01745	-80	49.77260
1c	31	24.40351	-80	54.92262
2c	31	24.74622	-80	53.18918
3c	31	25.07383	-80	52.08526
4c	31	25.09364	-80	51.87724
5c	31	25.17616	-80	49.81490
6c	31	23.95064	-80	55.06502
7c	31	23.59087	-80	53.34518
8c	31	23.86731	-80	52.59335
9c	31	23.65520	-80	50.97569
10c	31	24.14553	-80	50.55654
11c	31	23.03155	-80	54.96453
12c	31	23.27727	-80	53.77407
13c	31	22.74405	-80	52.30637
14c	31	23.37359	-80	50.98190
15c	31	22.65134	-80	50.71109
16c	31	21.96756	-80	54.48419
17c	31	22.02698	-80	53.92488
18c	31	21.85609	-80	52.92552
19c	31	22.50373	-80	51.76716
20c	31	22.23577	-80	50.54415

Appendix A. Continued.

Station ID	Latitude (deg.) (min.)		Longitude (deg.) (min.)	
1d	31	24.62330	-80	54.88101
2d	31	25.21449	-80	53.99106
3d	31	25.13626	-80	52.82599
4d	31	24.53304	-80	50.97748
5d	31	24.62840	-80	50.44365
6d	31	24.23812	-80	54.29253
7d	31	23.50556	-80	53.11191
8d	31	23.99138	-80	52.21879
9d	31	24.17473	-80	51.62786
10d	31	23.64348	-80	50.08897
11d	31	22.99593	-80	54.19388
12d	31	23.37043	-80	53.75872
13d	31	23.23952	-80	52.08325
14d	31	23.49556	-80	51.92499
15d	31	22.62735	-80	49.72611
16d	31	21.76230	-80	54.41351
17d	31	22.56757	-80	53.75213
18d	31	22.36767	-80	52.56286
19d	31	21.88656	-80	51.01494
20d	31	22.01265	-80	50.57162
1e	31	24.78256	-80	54.45755
2e	31	24.98615	-80	54.00371
3e	31	24.95784	-80	52.08814
4e	31	24.89510	-80	51.53250
5e	31	24.87212	-80	50.55375
6e	31	23.62872	-80	55.16697
7e	31	23.61741	-80	53.46149
8e	31	24.06775	-80	52.35983
9e	31	23.82149	-80	50.96409
10e	31	23.58871	-80	50.75686
11e	31	22.83675	-80	54.44967
12e	31	23.21142	-80	53.38719
13e	31	23.32605	-80	52.31829
14e	31	22.77795	-80	51.76480
15e	31	22.76366	-80	50.64584
16e	31	22.41108	-80	54.18060
17e	31	21.80730	-80	53.08733
18e	31	22.02829	-80	52.71509
19e	31	22.49182	-80	50.94003
20e	31	21.83365	-80	49.81972

Appendix A. Continued.

Station ID	Latitude (deg.) (min.)		Longitude (deg.) (min.)	
1f	31	24.73661	-80	54.47453
2f	31	24.87316	-80	53.62181
3f	31	24.41350	-80	52.55586
4f	31	24.97358	-80	51.30181
5f	31	24.52090	-80	50.47158
6f	31	23.80298	-80	55.21703
7f	31	23.83162	-80	53.88656
8f	31	23.55372	-80	52.84845
9f	31	24.14494	-80	51.07384
10f	31	23.52062	-80	50.17957
11f	31	22.70888	-80	54.87561
12f	31	22.80653	-80	53.51094
13f	31	23.06805	-80	52.39135
14f	31	23.10627	-80	51.67327
15f	31	22.93641	-80	50.76290
16f	31	21.83861	-80	54.57544
17f	31	22.19404	-80	54.09594
18f	31	22.37859	-80	52.11074
19f	31	21.98098	-80	51.20295
20f	31	22.22865	-80	50.42823

APPENDIX B

Field Sheets for Gray's Reef Sampling: Cruise FE-00-06-GR

APPENDIX C

Calibration Service Records for Datasonde Instruments

APPENDIX D

Ship Operations Evaluation Form: Cruise FE-00-06-GR